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BRIEF COMMUNICATION

The Influence of Comorbid Conditions on Graft Stenosis in Patients with Coronary Artery Bypass Graft Operation

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Abstract

The primary goal of coronary artery bypass grafting is to achieve complete revascularization with grafts that will remain patent throughout the patient's lifetime. This study investigated the association between bypass graft patency and comorbidity burden determined by Charlson comorbidity index (CCI) among patients with previous bypass operation who underwent a control angiography. One-hundred and two patients who had undergone CABG in the past were included to the study. Critical stenosis was defined as 50% or greater coronary luminal obstruction of any coronary vessel or its lateral branch. Patients were divided into 2 groups group 1; critical graft stenosis; (54 pts; 41M, mean age 66.5 ± 7.8 years), group 2; graft patent (48 pts; 31M, mean age; 65.9 ± 8.2 years). Charlson comorbidity index (CCI) and modified CCI scores were used for detecting comorbidities. The comparison of continuous variables between the control and critical CAD groups was performed by the independent sample test. A p value less than 0.05 was considered statistically significant. The two groups were statistically similar with respect to demographic properties, time since bypass operation, cardiovascular risk factors, systolic blood pressure, heart rate, medications used, complete blood counts parameters, and lipid profiles. CCI was significantly higher in Group 1 compared to Group 2 (7.14 ± 2.02 vs 4.72 ± 1.58; $p < 0.001$). Modified CCI scores were also higher in Group 1 than in Group 2 (6.14 ± 2.02 vs 3.73 ± 1.60; $p < 0.001$). Graft occlusion was more common among patients with a high comorbidity burden. CCI scoring system may be helpful for determining patients at increased risk at both the preoperative and postoperative periods.

Keywords

Coronary Artery Disease; Myocardial Revascularization; Coronary Stenosis; Comorbidity; Vascular Patency.

Introduction

Coronary artery bypass grafting (CABG) operation remains an important procedure despite advances in percutaneous transluminal coronary angioplasty.[1] The ultimate goal of CABG is to ensure the long-term symptom-free patency of bypass grafts.[2] It is known that graft patency is dependent on several factors such as operative factors, graft selection, vessel diameter, postoperative medication use, and patient compliance.[3] Charlson comorbidity index (CCI) is a global index obtained from a cohort of general medical patients that is widely used to detect comorbidities among various populations.[4] This study investigated the association between bypass graft patency and comorbidity burden determined by CCI in patients with previous bypass operation who underwent a control angiography procedure for any reason.

Methodology

One hundred and two patients with a history of CABG after presenting with acute coronary syndrome or who underwent coronary angiography for any reason were included in the study (72 M, 30 F; mean age 66.2 ± 7.9 years). Coronary angiography was performed in all patients due to stable angina pectoris (SAP), unstable angina pectoris (UAP), non-ST elevation myocardial infarction (NSTEMI), and ST elevation myocardial infarction (STEMI). A monoplane angiography system (Artis Zee, Siemens Erlangen, Germany) was used for all coronary angiography procedures. Critical stenoses were

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defined as 50% or greater coronary luminal obstruction affecting any coronary vessel or its lateral branch. The stenosis percentage was defined through the consensuses of two separate operators. Charlson co-morbidity index (CCI) and modified CCI score (calculated by subtracting 1 point from the original CCI score) were used to detect comorbid conditions. The patients were categorized into two groups based on severity of bypass graft stenoses. Group 1 consisted of 54 patients with critical graft stenoses (41 men, 13 women; mean age 66.5 ± 7.8 years), and group 2 of 48 patients (31 men, 17 women; mean age 65.9 ± 8.2 years). Detailed patient history was taken from each patient, and data on demographic characteristics, medications, systolic and diastolic blood pressure and heart rate were recorded. Fasting blood glucose levels, lipid profile, renal and hepatic function tests were obtained from venous blood samples taken at the time of admission. All patients underwent transthoracic echocardiography to quantify ejection fraction and left ventricular diameters. The local ethics committee approved the study.

Statistical analysis

All statistical analyses were carried out using SPSS for Windows 13.0. The Kolmogorov-Smirnov test was used to test the normality of quantitative data distribution. The Chi-square test and Fisher's Exact Chi-Square test were used to compare categorical variables between the groups. The comparison of continuous variables between the control and critical coronary artery disease (CAD) groups was performed by the independent sample test when the parametric test assumptions were met and by Mann-Whitney U test when the parametric test assumptions were not met. The association between time since the bypass operation and scores were analyzed by Pearson's/ Spearman correlation analysis. The statistical significance was set at $p < 0.05$ and the confidence interval at 95%.

Results

The two groups were statistically similar with respect to demographic properties, time since bypass operation, cardiovascular risk factors, systolic blood pressure, heart rate, medications used, complete blood counts parameters, and lipid profiles (Table 1). CCI score were significantly higher in Group 1 compared to Group 2 (7.14 ± 2.02 vs 4.72 ± 1.58; $p < 0.001$). Modified CCI score was also higher in Group 1 than in Group 2 (6.14 ± 2.02 vs 3.73 ± 1.60; $p < 0.001$). There was no correlation between time since bypass operation and CCI score.

Discussion

CABG is a globally recognized procedure that not only cures angina pectoris, but also improves cardiac functions and life expectancy. Saphenous grafts were initially used for the procedure, which were later followed by internal thoracic and radial arteries.[5] Saphenous veins are the most commonly used conduits, 50% of which remain patent without flow-limiting stenoses by 10 years. Early graft restenosis is a process characterized by the activation of various molecular pathways and cellular components, and the simultaneous activation of hemostatic systems with endothelial dysfunction and oxidative stress ultimately results in the appearance of a systemic inflammatory response.[6] During the intermediate and long terms, on the other hand, intimal hyperplasia and superimposed atherosclerosis are the main responsible mechanisms for graft occlusion.[7]

In a large-scale study from the Cleveland Clinic, the main factors causing reoperation were a young age at operation and graft type; other factors include incomplete revascularization, higher NYHA functional class, ventricular dysfunction, and single- or two-vessel disease at the initial operation.[8] In a study by Goldman et al.,[9] the main factors determining long-term graft patency included graft type (internal mammary artery - IMA - better than venous grafts), left anterior descending artery – LAD - being the bypassed vessel, and bypassed vessel being larger than 2 mm. Desai et al.[10] showed that radial artery grafts had an important effect on long-term graft patency, which was more pronounced among women. They also demonstrated that the diameter of the bypassed vessel and bypass grafting proximal stenoses were determinants of bypass patency.

In our study, the mean time since bypass operation was 7.6 ± 4.3 years. Patients who had occluded bypass grafts more commonly had saphenous grafts. There were no differences between patients with and without graft occlusion with respect to graft type, time since bypass, risk factors, and medications. However, CCI and modified CCI scores were significantly higher in the graft occlusion group. Despite similar demographic characteristics and risk factor profiles, the significant difference between the CCI scores may have contributed to the restenosis process.

Table 1 - Demographic, laboratory, echocardiographic parameters and Charlson comorbidity indices of the groups. (Data with normal distribution were expressed as mean ± SD, and data with abnormal distribution were expressed as min-max; median)

	Occluded graft (n = 54)	Patent graft (n = 48)	p
Age (years)	43 - 89; 66.5	47 - 83; 66	0.72
Gender (M, n)	44	31	0.06
Systolic blood pressure (mm Hg)	90 - 190; 127	90 - 180; 130	0.87
Diastolic blood pressure (mm Hg)	78.5 ± 12.2	78.0 ± 11.0	0.85
Heart rate (beat/min)	58 - 114; 82	53 - 106; 78	0.18
SAH (n)	39	32	0.65
DM (n)	25	19	0.55
Family history of CAD (n)	13	12	0.86
Hyperlipidemia (n)	31	30	0.51
Smoking (n)	11	9	0.67
Duration (years)	1 - 23; 8	2 - 22; 7.5	0.97
Total cholesterol (mg/dL)	105 - 289; 185	129 - 351; 210	0.11
Triglyceride (mg/dL)	56 - 641; 140	62 - 507; 184	0.22
HDL (mg/dL)	45.9 ± 11.7	44.6 ± 12.8	0.65
LDL (mg/dL)	114.1 ± 40.1	123.1 ± 42.9	0.32
CCI	7.1 ± 2.0	4.7 ± 1.6	< 0.001
Modified CCI	6.1 ± 2.0	3.7 ± 1.6	< 0.001
Occluded IMA (n)	4	-	
Occluded saphenous graft (n)	50	-	
Occluded radial graft	0	-	
EF (%)	45.0 ± 8.2	46.9 ± 9.9	0.36
Beta blocker (n)	29	18	0.41
ACEI (n)	46	39	0.42
Statin (n)	25	20	0.13
Nitrate (n)	6	2	0.33
Diuretic (n)	12	9	0.95
OAD (n)	20	18	0.23
Insulin (n)	7	5	0.43

Abbrevations: M: male, SAH: sstemic arterial hypertension, DM: diabetes mellitus, CAD: coronary artery disease, HDL: high density lipoprotein, LDL: low density lipoprotein, CCI: Charlson comorbidty index, IMA: internal mammary artery, EF: ejection fraction; ACEI: angiotensin-converting enzyme inhibitor; OAD: oral antidiabetic drugs.

Conclusion

Graft occlusion is more common among patients with a high comorbidity burden. Our opinion is that considering comorbid conditions along with conventional atherosclerotic risk factors at the preoperative and postoperative periods would have a favorable impact on graft patency among patients undergoing bypass surgery. The CCI scoring system may be helpful to identify patients at increased risk at both the preoperative and postoperative periods.

Author contributions

Conception and design of the research: Karabag T. Acquisition of data: Karabag T, Sahin B, Coskun E, Somuncu UM, Cakir MO. Analysis and interpretation of the data: Karabag T, Somuncu UM. Writing of the manuscript: Karabag T, Kalayci B, Coskun E, Cakir MO. Critical revision of the manuscript for intellectual content: Kalayci B, Coskun E. Supervision / as the major investigador: Karabag T.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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